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by

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Marine Technology

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## I. INTRODUCTION

The training of marine technicians has increased with considerable rapidity in the last two years. Despite difficulties in defining the occupational field, the program has been developed by the American Association of Marine Colleges, 1948 national conference on "The Education and Training of Marine Technicians," I defined

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situation and demand of the field. I have found that such surveys, although valuable for its purposes, raised many subtle questions which needed answers. These answers can come only from the individuals themselves. The marine technicians and students enrolled in a marine technology program. This report may properly be classified as a personnel inventory survey.



## I. INTRODUCTION

The training of marine technicians has gathered much momentum in the last two years. Despite difficulties in defining the occupational field, colleges from coast to coast have developed a wide variety of programs. By way of review, in the American Association of Junior Colleges 1968 national publication on "The Education and Training of Marine Technicians," I defined the marine technician:

"Under the broadest definition, a marine technician is one whose education and experience qualify him to work in the area of marine technology employing the technical knowledge, methods, and skills . . . ."

". . . In the final analysis, the employer will determine whether an individual is classified as a marine technician or as an electronic technician." (1)

As of September 1, 1969, the National Science Foundation Sea Grant Programs had funded eleven institutions of higher education to develop curricula to train an estimated 400 marine technicians. These schools are:

University of Washington	Cape Fear Technical Institute
Oregon State University	Southern Maine Vocational Technical
Texas A & M University	Institute
College of Marin	Del Mar College
University of Miami	Smithsonian Institution
Santa Barbara City College	Washington Technical Institute

To gather a clearer picture of marine technology, many of these colleges conducted interviews and questionnaires with employers to determine the job classification and demand of the field. I have found that such surveys, although valuable for its purposes, omitted many viable questions which needed answers. These answers can come only from the individuals themselves, the marine technicians and students enrolled in a marine technology program. This report may properly be classified as a personnel inventory survey.

## II. SCOPE AND METHOD OF STUDY

The purpose of the personnel inventory was to determine the characteristics of individuals in the marine technology field so that schools and employers with current programs might treat the needs of their students or employees in a precise and understanding manner. A questionnaire was developed in 1969 to sample the personal characteristics of employed marine technicians and student trainees in marine technology programs.

Survey forms were sent to fourteen large organizations which were reported to employ marine technicians; ten firms replied, providing data on 111 individuals.

71 governmental employees  
40 private industry employees  
111 total questionnaires from ten organizations

For schools training marine technicians, thirteen received questionnaires; eight schools replied, providing data on 154 individuals.

Since there was a high percentage of returns from all organizations, the data provided in this report properly reflects a good sample of the proportion of the nation's individuals who work as marine technicians or as students moving through a trainee program. There was much additional information gathered in the survey which is not reported in this paper. The selection of presented data was based on those questions which I felt were most important in aiding schools and employers in the understanding of marine technicians.



### III. MAJOR FINDINGS

#### A. Marine Technicians Working in the Field of Marine Technology

(Not all questions were answered in each questionnaire)

<u>Number</u>	<u>Organizations</u>	<u>No. of Marine Technicians</u>
3	Governmental	71
7	Private	40
10	totals	111

##### 1. Personal History

	<u>No. of Persons</u>	<u>%</u>	<u>Category</u>
a. <u>Age Levels</u>			
	25	27%	29 years or younger
	31	34%	30-39 years
	24	26%	40-49 years
	12	13%	50 years or older
b. <u>Sex</u>			
	87	95%	Male
	5	5%	Female
c. <u>Marital Status</u>			
	12	13%	Single
	75	84%	Married
	3	3%	Divorced
d. <u>Ethnic Group</u>			
	103	97%	Caucasian
	3	3%	Black
e. <u>Present Address</u>	32 were employed on the west coast		
	79 were employed on the east coast		
f. <u>Birthplace</u>			
	12	New York	3 No. Carolina
	11	Connecticut	2 Canada
	7	Pennsylvania	2 Maine
	6	California	2 Missouri
	6	Illinois	2 Texas
	5	Massachusetts	1 Georgia, Indiana, Kansas,
	4	Ohio	Maryland, Michigan, No. Dakota,
	4	Virginia	Oklahoma, Oregon, So. Carolina,
			So. Dakota, Washington, D.C.,
			Wisconsin, and Phillipines
g. <u>Military Service</u>	71% served in the Armed Forces; 29% did not		

<u>No.</u>	<u>%</u>	<u>Branch</u>
39	51%	Navy
19	25%	Army
11	14%	Air Force
4	5%	Marines
2	2½%	Coast Guard
2	2½%	Maritime Service



## Major Military Service Specialties

24	33%	Electronics
23	33%	Radar/Radio, Sonar, Communications
8	9%	Machinists, Mechanics
5	7%	Ordnance

## 2. Socioeconomic Status

### a. Marital Status of Parents

87% of the marine technicians reporting stated that their parents are still married.

### b. Number of Brothers and Sisters

62% had between 0-5 brothers and sisters.

34% reported 6-10 brothers and sisters

Three individuals stated that they came from families numbering at least 15 brothers and sisters!

### c. Occupation of Father

56% reported that the father is or was a blue collar worker.

16% stated that the father is or was a white collar worker.

34% reported the father's annual income occurs in the \$5,000-\$10,000 range

46% reported the father's annual income occurs in the \$11,000-\$15,000 range

### d. Education of Parents

	Fathers	Mothers
Less than high school=	42%	22%
High school degree=	47%	63%
College degree=	14%	7%

## 3. Employment Status

### a. Marine Technician Classification

85% classified themselves as marine technicians

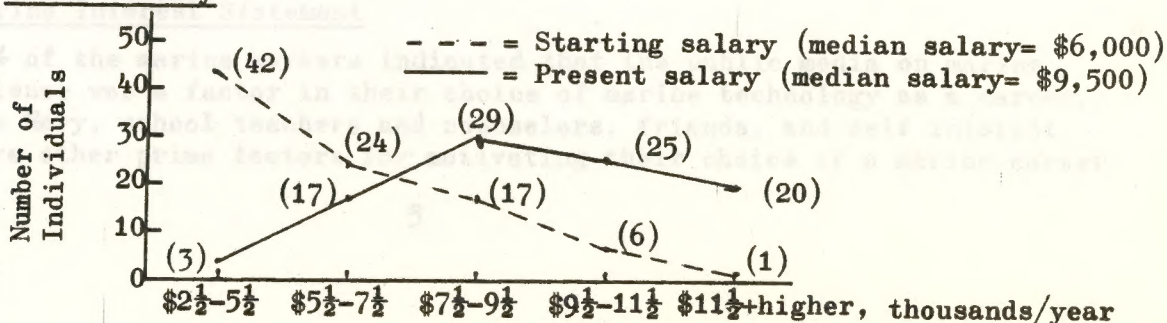
15% did not

About 55% had spent less than 5 years on their present job, while 20% had spent 20 years or more on their present job.

### b. Specific Job Title

(33%) 35 electronic engineers  
 11 marine service engineers  
 9 engineering technicians/aides  
 7 survey technicians  
 7 research helpers or lab technicians  
 7 mechanical engineers  
 5 field service technicians  
 4 physical science technicians  
 21 miscellaneous technicians and helpers- electronics, drafting, oceanographic, chemical, cartographic, etc.

### c. Annual Salary





d. Past Marine Related Work

6 indicated they had no previous experience in marine work  
83 stated they had marine work experience in research, electronics, communications, etc. Of the 83, 12 had seaman experience.

e. Other Statements regarding Employment

(1) About 33% stated they are satisfied with their present marine technology jobs, while the same percentage desired more ocean research jobs.

(2) Concerning the amount of desirable work time at sea:

2% desired 75% or more work time at sea

17% desired 50%+ time at sea

31% desired 30-40% time at sea

50% desired 25% or less work time at sea

4. Education

a. Amount of Education

(1) 95% of the working marine technicians completed high school. Their average high school grade was about a B-. Of the total who answered, most high school graduates took life science courses (biology), physics, chemistry, and general science. Algebra was the most common math course completed and a large percentage had at least one course in a foreign language. About 40 of the group had vocational-shop courses and most said these were relevant to their jobs.

(2) Of the 74 who went on to a college or a technical institute, 24 (or 32%) earned some form of degree:

10 earned junior college degrees

12 earned B.A., B.S. degrees

2 earned M.A., M.S. degrees

70% of those who had earned degrees expressed a desire to go on for higher degrees

75% of those who did not complete college education desire to return for a B.A. degree.

The average grade for those who attended college was about a B.

b. College majors

The majority indicated that they majored in engineering and electronics. Many of these desired more electronics and physical sciences and math education to enhance their present work.

c. College courses

(1) Math was considered the most important college course. The next most important were physics and electronics.

(2) The least important college course, in their opinion, were the foreign languages, literature and sociology.

5. Marine Interest Statement

19% of the marine workers indicated that the public media on marine science was a factor in their choice of marine technology as a career. The Navy, school teachers and counselors, friends, and self interest were other prime factors for motivating their choice of a marine career.



**B. Students Studying Marine Technology**  
(not all questions were answered in each questionnaire)

Number of Schools

13 requested survey forms

8 returned survey forms from 154 students

**1. Personal History**

	<u>No. of Persons</u> %		<u>Category</u>
a. <u>Age Levels</u>			
	97	65%	20 years or younger
	42	28%	21-29 years
	10	7%	30-39 years
b. <u>Sex</u>			
	148	96%	Male
	6	4%	Female
c. <u>Marital Status</u>			
	116	81%	Single
	24	17%	Married
	3	2%	Divorced or Widowed
d. <u>Ethnic Group</u>	152	100%	Caucasian
e. <u>Present Address</u>	64 West coast students		
	90 East coast students		
f. <u>Birthplace</u>	38	Maine	6 Oregon
	18	New York	4 Florida
	12	Washington	4 Idaho
	10	California	n other states with
	8	Massachusetts	small numbers
g. <u>Military Service</u>	43% served in the Armed Forces; 57% did not.		
	<u>No.</u>	<u>%</u>	<u>Branch</u>
	12	29%	Army
	10	24%	Navy
	9	22%	Marines
	8	20%	Air Force
	2	5%	Coast Guard

**2. Socioeconomic Status**

a. Marital Status of Parents

84% of the students' parents are still married.

b. Number of Brothers and Sisters

80% of students had 3 or fewer brothers and sisters.

18% had 4-6 brothers and sisters.

2% had 7 or 8; none had more than 8.

c. Occupation of Father

61% reported that the father is or was a blue collar worker

39% reported that the father is or was a white collar worker



57% stated the father's annual income occurs in the \$5,000-10,000 range.  
43% reported the father's annual income occurs in the \$11,000-15,000 range.

d. Education of Parents

	<u>Fathers</u>	<u>Mothers</u>
Less than high school=	13%	2%
High school diploma=	77%	91%
College degree=	9%	10%

3. Employment Status

Students are generally employed in part-time work which required little previous experience: e.g., restaurant work, custodial work, store clerks, etc.

7% classified their jobs (mostly part-time) as marine technicians  
93% did not consider their jobs to be marine technician work

Only 7% of the working students classified their work as full time. These students are probably night school students. Those who classified their work as marine technician reported these positions: marine machinist, worker in a SCUBA shop, fishermen, and marine technician laboratory aide. All other job titles were unrelated to the marine field. Most of the student jobs were summer jobs with varied salaries.

Of the students who had past marine related work experiences, these were the ones reported:

<u>No. of Students</u>	<u>Type of marine experience</u>
13	SCUBA diving
14	Fishing, commercial fishing
6	Seaman
n	others: ship building, lab technician, oceanographic ship research, aquaria work, etc.

If students were to be employed as marine technicians, the highest peak of expected, fair starting annual salary ranges from \$5,500 to \$7,500. The majority desired jobs in oceanographic research, especially east coast students. West coast students desired more diving work than east coast students.

Concerning the desirable amount of job time spent at sea:

27% desired 75% or more job time at sea  
40% desired 50%+ time at sea  
21% desired 30-40% time at sea  
12% desired 25% or less time at sea

4. Education

a. High School Education

100% of the students completed high school. Their average high school grade is about a C+. As in most high schools, science, foreign languages and math played an important course role. Algebra was most often checked as an important course. Marine biology-oceanography courses appeared in their high school curricula.

b. College Education

82% expressed a desire to go on for higher degrees, while 18% stated they do not plan to go further than their present status

of junior college degree. Their current grade average appears to be about a C+.

While these students were classified by the school as marine technology students, the students listed themselves with the following majors:

No. of Students	Major	Most Important College Courses	
		No. of students	Course
40	Marine Technology		
16	Oceanography	33	Oceanography
7	Biology	30	Math
6	Marine Biology	26	Marine Biology
5	Ocean Engineering	24	Biology
2	Chemistry	21	Physics and Chemistry
n	Geology, liberal arts, etc.	4	Electronics
		Least Important College Courses	
		19	English, Communications, Literature
		18	Physical Education, Health Ed
		7	Math
		6	Sociology

#### 5. Marine Interest Statements

64% of the students stated that the public media influenced their choice of marine technology as a career.

The overwhelming majority of marine technicians are white— 97% of the workers and 100% of the reporting students. No orientals, Mexican-Americans, nor Indians were listed, with only three blacks among 107 questionnaires. A sociological and psychological study should be undertaken to determine the reason for this white-dominated occupation. Further, there is a current attempt to train the "hard-core unemployed", which includes a large proportion of blacks, in Washington, D.C. through the activated hydrographic vessel, the "Explorer." An evaluation study of this program is needed to supply information in all institutions involved in marine technology programs.

#### 3. Birthplace and Area of Longest Residence

About 57% of working marine technicians and 62% of the students were born in coastal states. For areas of longest residence, 53% of the workers and 90% of the students lived 10-25 years in coastal states. Thus, individuals involved in marine programs generally come from states abounded by the ocean.

#### 6. Military Service

The predominance of military service for marine technician workers, 71%, was evident. The majority, 51%, served in the Navy and this training influenced many to choose marine technology as a career. On the other hand, students showed a smaller percentage balance between service in the Army, Navy, Marine Corps, and Air Force.

Also, the marine technician workers, 53%, had electronic and communication training in the armed forces, which tended to support their marine technology positions.



#### IV. MAJOR INTERPRETATIONS

10 organizations, employing marine technicians	= 111 technicians
8 schools, training marine technicians	= 154 students
18 totals	265 questionnaires returned

##### A. Personal History

###### 1. Age Levels

Working marine technicians are grouped in the middle age levels, between 30-49 years old. The majority, 65%, of the students are 20 years or younger.

###### 2. Sex

In both groups, technicians and students, 95% are males. From my previous surveys on the demand for marine technicians, employers have stated that women are needed, but few are qualified.<sup>(1)</sup> Many employers are puzzled as to why more women are not involved in marine technical training, especially for lab-type positions.

###### 3. Marital Status

The statistics reveal the difference between workers and students. About 84% of the workers are married; 81% of the students are single and most will probably evolve towards the marriage status.

###### 4. Ethnic Group

The overwhelming majority of marine technicians are white-- 97% of the workers and 100% of the reporting students. No orientals, Mexican-Americans, nor Indians were listed, with only three blacks among 265 questionnaires! A sociological and psychological study should be instigated to determine the reason for this white-dominated occupation. However, there is a current attempt to train the "hard-core unemployed", which includes a large proportion of blacks, in Washington, D.C. aboard the deactivated hydrographic vessel, the "Explorer." An evaluation study of this program is needed to supply information to all institutions involved in marine technology programs.

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Also, the marine technician workers, 33%, had electronic and communication training in the armed forces, which tended to support their marine technology positions.

## B. Socioeconomic Background

### 1. Marital Status of Parents

For the worker group, 87% of the parents are still married as compared to 84% for the student group. The majority of those who were divorced have remarried. Does the stability of the home life affect the longevity of students completing their education and being dependable workers? Some sociologists believe there is an effect when family life has been disrupted. My personal view is that there is little evidence of effect for the group as a whole for such a small percentage of divorced parents. For the individual student, however, there may be some effect.

### 2. Occupation of Father

Generally, technical students come from homes where the father holds a blue collar job. This fact was supported in this survey; 56% of the workers and 61% of the students stated their fathers are blue collar workers. The remaining fathers are white collar workers.

The annual incomes of the workers' fathers showed a higher percentage, 46%, in the \$11,000-\$15,000 range than in the \$5,000-\$10,000 range. The reverse was true for the students who reported a higher percentage, 57%, of the fathers' incomes in the \$5,000-\$10,000 level. Generally this trend illustrates a time factor; the longer the father has worked, the higher the income. In general, the average income of the fathers seems to be adequate for the average family maintenance.

What was not measured and probably a very influential factor in the success of marine technology workers are the parental attitudes toward college. Cross<sup>(3)</sup> reported that parental attitudes towards college influence a strong relationship to the student's persistence in college.

### 3. Education of Parents

In accordance with the trend of blue collar workers and middle income wages, the expected formal education of the parents should be lower than that of the white collar families. Fathers with less than high school education numbered 42% for the worker group as contrasted with only 13% for the student group. For the worker group, 47% of the fathers held a high school diploma; however, for the student group, 77% of the fathers had completed high school education. There appears to be a trend that more and more blue collar workers are high school graduates. Perhaps in time, the percentage of blue collar workers who have completed college education will be higher, thus illustrating this increased educational trend of the general populace. A noteworthy statistic is the higher percentage of mothers than fathers with high school diplomas for both the worker and student groups. Cross<sup>(3)</sup> reports that in general, the more schooling the parents have had, the more likely the students will receive parental encouragement towards persisting in college.

## C. Employment Status of Marine Technology Worker and Student

### 1. Specific Job Title

About 85% of the working technicians classified themselves and their jobs as "marine technicians." However, if we were to look at their job titles, only two were classified as oceanographic aides. All others had other job titles, with 33% called electronic engineers. This data supports the fact that there is no large movement towards establishing a specific job title as "marine technician"; instead, technicians working



in the marine biome are classifying themselves as such. Likewise, employers using technicians in the marine field are also calling them "marine technicians" but with a variety of job titles.

Although the specific job title is not an established category, the efforts of schools throughout the country that train marine technicians will not be fruitless. These schools are training technicians who will eventually work in the marine environment and who will form the cadre of a large body that will one day be called marine technicians, many with a host of sub-specialties, e.g., electronics, diving, mechanical, biological, geological, etc.

Students training to be marine technicians generally are unaware of the complexity of job titles. About 7% felt that their jobs, while going to school, are encapsulated by the title, "marine technician."

## 2. Starting Salary

The median starting salary for marine technology workers was \$6,000 per year and the median present salary was \$9,500 per year.

The students in marine technology, 53%, generally expected a starting salary between \$5,500 to \$8,500 per year.

## 3. Past Marine Experience

A large majority, about 74%, of the working marine technicians reported they had past marine work experience. Approximately 14% of these had seaman experience. Most claimed experience in marine electronics.

In contrast, about 32% of the students claimed some form of marine experience, the majority having some experience as SCUBA divers or in some form of fishing. Very few of the marine technology workers listed SCUBA as a marine experience. The SCUBA trend is one of recent maturity.

## 4. Desirable Time at Sea

A very interesting contrast over the desirable amount of job time spent at sea occurred between the workers and the students. Only 2% of the workers desired 75% or more time at sea; 50% desired less than one-quarter of their time at sea. For the students, with only a few having had sea experience, 27% desired 75% or more time at sea and only 12% desired less than one-quarter of their time at sea. In time, this student interest in working in the sea will probably diminish to a more realistic percentage.

## D. Education

1. In both groups, workers and students, 95%-100% completed high school. Of the 111 workers, 74 went on to college or technical institute, with 24 or 32% of them earning some form of college degree.

Likewise, a high percentage wants to continue education towards higher degrees; 75% of the workers and 82% of the students expressed strong desires to go for B.A. or higher degrees. This desire of technical students to go on towards higher degrees is a well-recognized fact among educators, yet I have always wondered why these educators continually try to stifle these drives by setting up "terminal" technical curricula. Even when the student goes to work as a technician in private industry, it has been my experience that these employers set up advance pay scales to motivate these technicians to return to college for more schooling!

## 2. Important and Least Important College Courses

The marine technician workers declared that math and physical sciences (physics, chemistry) are extremely important college courses. The students, with very little concept of the nature of marine technology work, listed oceanography, math, marine biology and biology as high choices. From my 1967 survey of marine technology employers<sup>(2)</sup>, they listed electronics, chemistry, math, in a 1,2,3 order of importance. Such declarations by marine technician workers and employers should be wise advice for marine technology curricula developers.

Least important courses for both groups were generally "humanities" courses. However, the choice to decide what is most important is much easier than the discretion to express what is least important. The decision of describing least important courses may be clouded with bad experiences in grades, teachers, subject content, etc., and this is true for the other extreme. Nevertheless, the judgment of good or bad is always a difficult choice for educators.

## 3. Marine Motivation by Public Media

The final contrast between marine technician workers and students is seen in the percentage that were motivated towards a marine career by public media, e.g., the Jacques Cousteau television specials:

The workers = 19%  
the students= 64%

The contrast in the above percentages may give the reader a clue as to many of the forementioned differences between the two groups. If motivation is too superficial, the persistence in working in the rugged environment will not be lasting.



## V. CONCLUSION

The data presented in this report shows that the current marine technology workers and students come from families of solid middle class groups. Their average grades are in the C to B categories, and the overwhelming majority have a strong desire to go on for higher academic degrees. Furthermore, my surveys indicate that success as a marine technician requires an adequate background in math, the physical sciences, and electronics.

With the above information, I have revised some basic thinking in my mind about technical education at the junior or community college level. In the first place, I strongly support the technical-vocational training programs and their role in our economic system. However, the dilemma arises when reports come from around the country that there is a high dropout rate of students in marine technology college programs. A Pacific northwest college and a southern California college each started with about 70 students and graduated less than 10 in their marine technology programs. Such attrition rates may be true for all colleges with marine technology curricula. What is the reason? I conclude the following:

1. Many marine technology programs, following traditional technical-vocational course designs, are geared for students of low socioeconomic status who generally do not have the background to succeed in college. These curricula are attended by middle class students with strong drives for academic degrees. When enlightened by the fact that many of these courses are non-transferable (terminal), they quit the program.
2. The majority of marine technology programs have courses in math and science which are either too difficult for or unappealing to the many liberal arts students who sign up for the major. (Science students take up science majors.) Thus, the attrition rate accelerates because of the poor background training of students. These college courses are not designed to teach the basic A,B,C's of the subject matter.

My recommendations are really suggestions. The time is not too late to revise the system. I suggest two concepts:

1. A seamanship-type of technology could be taught at the secondary or technical school level. I strongly support the post-secondary-technical school concept. At this level there is no confusion about academic degrees. The Los Angeles Trade Technical College, in my opinion, is one fine example of a well-directed educational institution. Such centers should be widespread to provide success to the unskilled students.

2. Junior or community colleges have evolved so deeply into the "transfer" academic curricula that the original technical-vocational concept may never regain its importance. This latter concept is to teach technical-vocational courses that are simple and easily grasped by the non-academic students. There is nothing wrong with this concept. The problem arises when the two incongruous careers of the academic-based courses (e.g., marine technology) and the trade career courses (e.g., cosmetology) are lumped together into one single funding category. Under the single "vocational-technical" classification, both of the above mentioned programs must have courses that are non-transferable. From my studies, I definitely feel that the marine technology curricula must be free to develop into four-year degree programs. The restriction stems from federal and state vocational-technical funding requirements which force all such technical programs under the single "non-transferable" classification. If viable technical programs are to survive and benefit the interested students, such financial bonds must be made more flexible.

Therefore, my surveys, information, and conclusions are directed towards educators and employers who will hopefully rekindle the thought processes about all "technical" students. There is so much of politics, money, prestige, and red tape tied up into vocational-technical programs, and my compassion goes out to the students struggling through this maze. Out of it all, I hope the field of marine technology survives.

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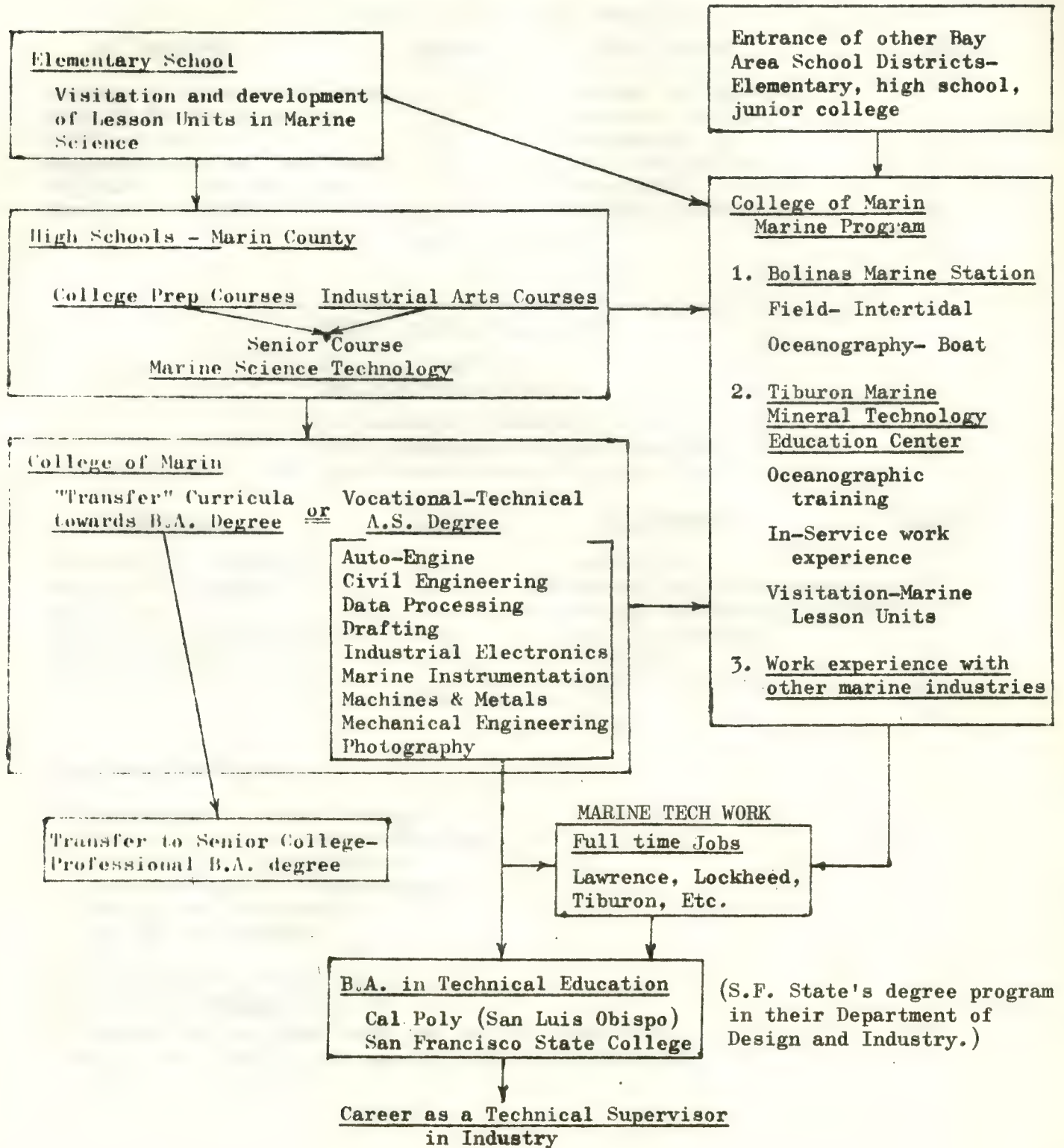
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MARINE TECHNOLOGY CURRICULA

CHART 1

MARINE PROGRAM RELATIONSHIPS



# PRIMARY MARINE TECHNOLOGY CURRICULUM

CHART 2

MARINE TECHNICIAN PROGRAM (September, 1969)

## Certificated Major in Marine Technology

### Associate of Science (A.S.) Degree Program

#### Emphasis: Marine Instrumentation

<u>1st Semester</u>	<u>Units</u>	<u>2nd Semester</u>	<u>Units</u>
*Geology 15 (Gen. Oceanography)	3	Biology 10 (General)	3
<sup>1</sup> Math 53 (Technical Math)	3	Computer Science 50	3
Electronics 61	4	Electronics 62	4
<sup>2</sup> Engineering 51 AB (Drafting)	2	American Studies	3
English or Communications	3	Electives	2
Physical Education	$\frac{1}{2}$	Physical Education	$\frac{1}{2}$
	15 $\frac{1}{2}$		15 $\frac{1}{2}$

#### SUMMER - Marine Experience

College of Marin's  
Bolinas Marine Station

U.S. Bureau of Mines at Tiburon-  
Ship experience and work experience

<u>3rd Semester</u>	<u>Units</u>	<u>4th Semester</u>	<u>Units</u>
Chemistry 11 (General)	4	Machine 59	3
**Physics 55 (General)	4	**Physics 50 (Instrumentation)	2
Geology 1A	4	Geology 20 (Oceanology Probs)	3
English or Communications	3	American Studies	3
Physical Education	$\frac{1}{2}$	Electives	4
	15 $\frac{1}{2}$	Physical Education	$\frac{1}{2}$
			15 $\frac{1}{2}$

#### Suggested Electives:

Biology 20A - Marine Biology  
Biology 21A, 21B - Marine Ecology  
Chemistry 31 - Calculations  
Electronics 60A - Fabrications  
Geology 56 - Mineralogy  
Art 48 - Photography

\* new course, September 1969

\*\* new course, ~~spring~~ 1970-71

<sup>1</sup> Eligibility for higher math may satisfy requirement

<sup>2</sup> May be satisfied by one year of high school drafting



## MARINE TECHNOLOGY COURSE-SUBJECT SKILLS

### Basic Objectives

Upon completing the course of study in the MARINE TECHNOLOGY PROGRAM, the student will have received:

1. Education in the broad aspects of marine sciences (oceanography).
2. Training in the general operation of electronic-instrumentation hardware, a basic requirement for employment in Northern California organizations and most Southern California organizations involved in marine activities.
3. Shipboard experience for those desiring to enter such opportunities.

<u>Course</u>	<u>Subject Matter Skills</u>
Biology:	Review of basic principles of life forms. Classification of animal and plant kingdoms. Molecular Biology (elementary), use of microscopes.
Computer Science:	Operation and use of card-punch operation, card input and output, calculators, tabulators. Operation of IBM 1401, 2B-1130. Relating ocean data problems to course work.
Electronics:	Basic principles and testing in: voltage and current measurements, transistors, vacuum tubes, schematics; use of VTVM, VOM, oscilloscope, signal generators, etc. Beginning review of marine-related electronic problems.
Engineering Drafting:	Mechanical drawing review, geometrical construction, orthographic and isometric projection techniques.
Geology:	Principles of stratification, rocks, minerals, map reading. Instruments: seismograph, spectroscope, transits, microscopes.
Mathematics:	Review of basic algebra; slide rules; technical math. Elementary trigonometry, statistics.
Oceanography & Oceanology Problems:	Review general principles of oceanography, submarine geology, mineralogy, mapping, ocean sampling techniques, future developments and careers in ocean-related industry, ocean experience on the school's marine boats.

### SUMMER EXPERIENCES

<u>Bolinas Marine Station</u>	<u>Tiburon Marine Minerals Laboratory</u>
Marine field experiences: intertidal, subtidal. Problems of lab instrumentation on ocean work. Use of computers, statistics on report writing. Small boat handling. Basic SCUBA diving- northern and southern California.	Shipboard work experiences aboard the 205-ft VIRGINIA CITY. This Bureau of Mines research vessel spends its summer months in undersea exploration of minerals. Ship experience will determine if the student is suited to a sea-vocational occupation.
Chemistry:	Basic review of inorganic, organic chemistry. Routine-elementary chemical analysis. Review of basic ocean-chemistry techniques.
Machine:	Review principles in basic machine tools, welding, lathe, grinders, milling, and other bench operations.
Physics:	General review of: mechanics, dynamic systems, thermodynamics, hydraulics, wave theory, vibrations, optics.
Physics Instrumentation:	Open laboratory project work by the marine technology students, utilizing marine data in a component instrumentation system. Learn to operate: signal conditioning, analog and digital readouts, impedance matching and ground loop problems, compatibility to the IBM 1401 and 1130.
Other Courses:	English, American Studies, Physical and Health Education to fulfill degree requirements for an Associate of Science (A.S.) Degree.

# CORRELATING MARINE TECHNOLOGY PROGRAM

## CHART 3

## MARINE TECHNOLOGY CURRICULA - ELECTRONICS MAJOR

One Example of using a Technology subject and adding marine course work to qualify the individual as a marine "electronic" technician:

<u>Industrial Electronics Technology</u>		<u>Marine Science Electives</u>	<u>Units</u>
<u>First Semester</u>	<u>Units</u>	Biology 10	3
ET 61 - Intro. Electronics	4	Chemistry 11	4
ET 60A- Electronic Fabric.	1	Marine Biology 20A	3
ET 65A- Electronic Math	3	Marine Organisms 21A	3
MMT 59- Machine Tool Proc.	2	Oceanography 15	3
Engr. 51AB- Geom. Drawing	2	Computer Science 50	3
English	3	Geology 1A and Lab	4
Physical Education	$\frac{1}{2}$	Mineralogy 56	4
	<u>15<math>\frac{1}{2}</math></u>		
<u>Second Semester</u>			
ET 62 - Applied Elec.	4		
ET 60B- Electronic Fabric.	1		
ET 265B- Elec. Math	4		
Engr. 26- Elec. Graphing	2		
English	3		
Health Education 2	2		
Physical Education	$\frac{1}{2}$		
	<u>16<math>\frac{1}{2}</math></u>		
<u>Third Semester</u>			
ET 63 - Inter Elec.	5		
ET 60C- Electronic Fabric.	2		
U.S. History	3		
Electives	6		
Physical Education	$\frac{1}{2}$		
	<u>16<math>\frac{1}{2}</math></u>		
<u>Fourth Semester</u>			
ET 64 - Adv. Elec.	5		
ET 60D - Electronic Fabric.	2		
Government	3		
Electives	6		
Physical Education	$\frac{1}{2}$		
	<u>16<math>\frac{1}{2}</math></u>		



APPENDIX 1

CALIFORNIA ORGANIZATIONS INVOLVED WITH MARINE SERVICES AND PRODUCTS

(Surveys conducted in 1967-69)

<u>No. of Firms</u>	<u>Types of Employable Technicians</u>	<u>Organizations</u>
29	Electronic	<p>- Typical statement: We want these employees to be nearly 100% trained in electronics</p> <p>Berkeley Instruments Bissett-Berman Corp. California Computer Products Chevron Oil Research Deep Ocean Technology DoAll Science Eimac of Varian Endevco Corp. General Dynamics Electric Boat Div. General Precision Granger Associates Hallikainen Instruments Hewlett-Packard Interstate Electronics Oceanics Division</p> <p>Bunker-Ramo Corporation Kaiser Aerospace Lockheed Missiles &amp; Space Northrop Corporation Ocean Science &amp; Engineering Syntex Laboratories Systron-Donner Texaco Research Univ. of California Lawrence Radiation Lab Wyle Laboratories U.S. Geological Survey Office of Marine Geol.&amp;Hydrology U.S. Bureau of Mines Marine Mineral Tech Center U.S. Naval Civil Engineering Pt. Hueneme U.S. Naval Radiological Defense Lab Watkins-Johnson</p>
14	Engineering	<p>Beckman Instruments Bissett-Berman Corp. Brown &amp; Caldwell Granger Associates Interstate Electronics Lockheed Missiles &amp; Space Northrop Corporation</p> <p>Ocean Science &amp; Engineering PEK U.C. Lawrence Radiation Lab NASA Ames Research Center U.S. Bureau of Mines Marine Mineral Tech Center U.S. Naval Civil Engineering U.S. Naval Missile Center Marine Bioscience Branch</p>
16	Oceanography	<p>- Typical statement: We want employees who are broadly trained in the physical sciences, with emphasis on basic electronics and sea-ship training.</p> <p>American Undersea Bunker-Ramo Corp. Crawford Marine Specialists Hopkins Marine Station Inter-American Tropical Tuna Commission Ocean Navigation Equip. Ocean Science &amp; Engr. Lockheed</p> <p>Union Oil Research U.S. Bureau of Mines U.S. Geological Survey- Marine Geology &amp; Hydrology U.S. Naval Civil Engineering U.S. Naval Oceanographic Office U.S. Naval Radiological Defense U.S. Naval Underseas Lab Interstate Electronics-Oceanics</p>



Appendix 1-continued

10	Biology	Berkeley Biologicals California Academy of Sciences Inter-American Tropical Tuna Commission County of Santa Clara Health Department Syntex Laboratories	NASA Ames Research Center U.C. Lawrence Radiation Lab U.S. Bureau of Sport Fisheries U.S. Naval Missile Center Marine Bioscience Branch U.S. Naval Undersea Warfare Center
9	Chemical	Beckman Instruments Brown & Caldwell Chevron Oil Research East Bay Municipal Water Utility Dist.	Furane Plastics Hallikainen Instruments County of Santa Clara Health Dept. Texaco Research A.S. Thomas Materials Lab
7	Physical Instrumentation, Physics, Geology	Beckman Instruments Chevron Oil Research General Precision Hallikainen Instruments	Hydril Company Mechanical Research Texaco Research
6	Drafting	Bechtel Corporation Beckman Instruments Bissett-Berman Corp.	Berkeley Instruments U.C. Lawrence Radiation Lab U.S. Naval Civil Engineering
5	Mechanical	Beckman Instruments Hallikainen Instruments NASA Ames Research	Ocean Science & Engineering U.C. Lawrence Radiation Lab
5	Data Processing Math, Computer	Chevron Oil Research Hydril Company NASA Ames Research	U.C. Lawrence Radiation Lab U.S. Naval Civil Engineering
3	Photography	Chevron Oil Research General Dynamics-Electric Boat Division U.C. Lawrence Radiation Lab	
2	Optical	Beckman Instruments Do All Science Center	
1	Cartography	U.S. Geological Survey	
1	Machines	Do All Science Center	
1	Metal	Hallikainen Instruments	
1	Sonar	General Dynamics- Electric Boat	
2	Electrical	Beckman Instruments Do All Science Center	

Notes: The College of Marin Math Placement Test must be taken to ensure correct placement.  
For further information or interview, contact: Mr. Gordon Mann Phone: 434-1062  
College of Marin  
San Rafael, California 94901



**COLLEGE of MARIN  
KENTFIELD, CALIFORNIA 94904**

**MARINE TECHNOLOGY APPLICATION**

NAME \_\_\_\_\_ DATE \_\_\_\_\_  
           Last                      First                      Middle Initial                      DATE of BIRTH \_\_\_\_\_  
 MAILING ADDRESS \_\_\_\_\_ PLACE of BIRTH \_\_\_\_\_  
 CITY \_\_\_\_\_ STATE \_\_\_\_\_ ZIP \_\_\_\_\_ PARENT or GUARDIAN and ADDRESS: \_\_\_\_\_  
 TELEPHONE NO. \_\_\_\_\_  
 HIGH SCHOOL ATTENDED \_\_\_\_\_  
 ADDRESS of SCHOOL \_\_\_\_\_  
 HIGH SCHOOL COUNSELOR \_\_\_\_\_ COLLEGE COUNSELOR \_\_\_\_\_

**Check Courses Completed in High School:**

<u>MATHEMATICS</u>	<u>SCIENCE</u>	<u>TECHNICAL</u>
Algebra <input type="checkbox"/> 1st year	General Science- <input type="checkbox"/>	Electronics- <input type="checkbox"/> 1st year
<input type="checkbox"/> 2nd year	Biology- <input type="checkbox"/>	<input type="checkbox"/> 2nd year
Geometry - <input type="checkbox"/>	Chemistry- <input type="checkbox"/>	Wood Shop- <input type="checkbox"/>
<u>Name other math</u>	Physics - <input type="checkbox"/>	Metal Shop- <input type="checkbox"/>
<u>courses:</u>	Marine Sciences- <input type="checkbox"/>	Mechanical- <input type="checkbox"/> 1st year
<input type="checkbox"/>	<u>Others:</u>	Drawing <input type="checkbox"/> 2nd year
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	(Others) <input type="checkbox"/>

List college courses completed in the appropriate columns:

What other experiences have you had that pertains to the field of marine technology?  
 (e.g., swimming, SCUBA, etc.)

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**Note:** The College of Marin Math Placement Test must be taken to ensure correct placement.  
 For further information or interview, contact: Mr. Gordon Chan Phone: 454-3962  
 College of Marin  
 Kentfield, California 94904